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# APPLYING EARTH MATERIAL IN CONTEMPORARY ARCHITECTURE TO IMPROVE INDOOR ENVIRONMENTAL QUALITY — CONSTRUCTION RENOVATION EXPERIENCES OF AN ARCHITECTURE STUDIO IN SHIRAZ, IRAN

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## Abstract

Climatic concerns, decrease of resources, and inefficient buildings that result from applying conventional unappropriated materials and techniques are the factors leading many countries to consider ecofriendly, local and sustainable methods and materials in contemporary architecture. As earth was one of the most prominent materials in ancient architecture which has demonstrated lots of ecological, sociocultural and aesthetic benefits attracts many countries to revive back the use of this traditional material. Nevertheless, lack of knowledge, professionals and technicians in this field make constructing a full earth building very challengeable in some cities like Shiraz. But using this material in interior architecture and renovation projects is more possible, can represent healthier spaces, in addition to providing a better thermal comfort for users. Two renovation projects using earth techniques, will be explained. Wattle-and-daub and light earth is applied to make an interior partition and an adobe seat is designed as a thermal mass in a greenhouse. It is tried to use local techniques and available materials like pomegranate sticks, straw and clay to represent simple and responsive techniques in interior spaces. Sarooj plaster and innovation in using this traditional Persian mortar to make an interior vertical sunshade will be also explained, aimed to regenerate earth techniques in contemporary interior architecture. The functions of the projects are a home office and an obstetrics and gynecology office, located in Shiraz, Iran.

**Key words:** Interior Earthen Partitions, thermal mass, Sarooj, IEQ

## Introduction

Earth architecture has been an original way of building habitats for thousands of years but after the Industrial Revolution is rarely used. However, the climatic crisis and decreasing energy resources in the last decades cause thinking about sustainable development and green architecture. This Leeds to studies and learning more about earth architecture by academic and professional architectural circles, for undeniable ecological potential of this natural material. Although earthen materials still

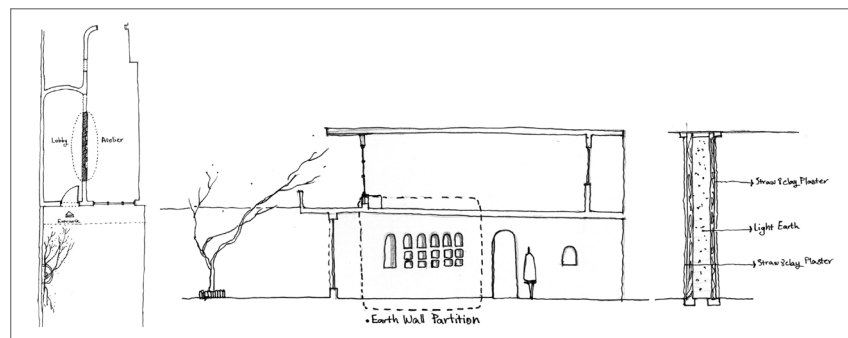


Figure 1. The location of the earth wall partition in the project and its wall section.



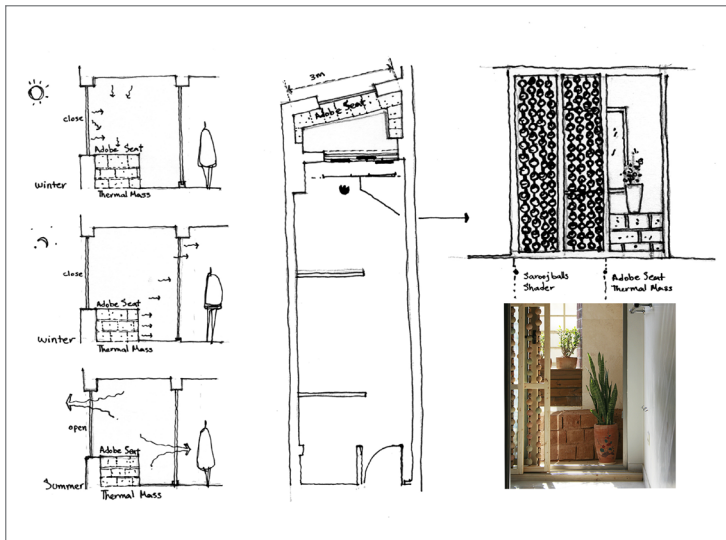
Figure 2. The building process of the earth wall partition and final plaster.

challenge restrictive legislation and standards that do not allow their use in many countries (Moriset et al., 2021). While using this material in indoor spaces face fewer obstacles. Studies indicate that this natural material can approve indoor environmental quality (Zare Mohazzabieh et al., 2019). This article will show some examples of using earth material in interior architecture, which is designed by Gel Studio Architects in Shiraz, Iran. The main focus of our activity in this small studio is researching vernacular and contextual architecture also using passive design and natural material in projects to ameliorate the quality of indoor spaces.

## Wattle-and-daub and light earth

### Interior partition

This project is located in the historic part of Shiraz city in Iran. It is an adaptive reuse of a house to a home-office. The house is not a traditional one, it has two floors and a little yard with an area of about 200 square meters. Indoor air quality and ventilation is not acceptable in the current situation of the building. Improving IEQ while approving a suitable relation between interior spaces are the main goals of this project. According to design responses, an internal partition must be added to the first floor, to separate and define the independence of the entrance lobby and the atelier, also upgrading natural ventilation of first the floor.



**Figure 3.** Function of the greenhouse in winter and summer, location of the Adobe Seat and Sarooj balls Shader.

It is decided to make this partition with natural and available material, which are pomegranate sticks, straw and clay. A timber frame is installed, then covered by pomegranate sticks on two sides. These sticks are obtained by pruning trees, they are strong and flexible, and can be converted to curved forms. The middle of the wall is filled with light earth. Straw and clay and water is used to make light earth. Straw has a higher proportion than other ingredients in this mixture. Two sides of this wall are plastered by straw and clay. This wall is made of waste sticks and straw and earth, these natural materials are completely recyclable, and have a beneficial role in improving IEQ.

## Interior design for a doctor`s office

### Greenhouse; thermal mass adobe seat

Location of this project is in the modern context of Shiraz city. It is an interior design for an obstetrics and gynecology office which is on the third floor of an apartment. The concept designs of this project are based on reducing patients` stress and improving IEQ.

South terrace of this office gave us this chance to design a greenhouse to moderate the humidity and temperature of the room. Adding a glazing to this trace, and an adobe seat as a thermal mass, return it to a greenhouse. Figure3, shows the function of this greenhouse in winter and summer.

It is tried to minimize the weight of this seat. The amount of straw of the components is more than traditional adobes` components, the size of adobes is calculated according to the height and width of the seat. Two types of molds to make tongue and groove joints are designed to facilitate masonry operations and reduce the amount of masonry mortar. The surface of the seat is plastered by a finer aggregate of straw, clay and lime. Linseed oil is applied to the whole sides of the seat to make the final surface more resistant.



**Figure 4.** The process of making adobes and constructing the Adobe Seat.



**Figure 5.** The process of making Sarooj Balls and installing the shader in the Ultrasound Room.

## Interior Design for a Doctor`s office

### Sarooj Ball Shader

According to the rules of the medical system of Iran, it is mandatory to have a curtain behind the window of examination rooms and ultrasound rooms, to provide privacy. It is tried to consider different parameters in designing this curtain; beauty, using natural material, and providing a delicate and diverse view of light and shadow all day long in the room. These handmade shaders are made of Sarooj<sup>1</sup> mortar. Sarooj is a traditional water resistant mortar made of clay, lime and sand. It is tried to make a solid form by this mortar, 600 Sarooj balls are made by three people in two weeks. The balls are immersed in milk and finally coated with linseed oil to strengthen. They are completely recyclable, low embodied energy and can control acoustic to some extent. They are installed in a wooden frame, using a metal bar and wooden washers.

<sup>1</sup> Sarooj is a traditional water-resistant mortar used in Iranian architecture, for constructing bridges, and ice storages or earth refrigerators (Yakhchal). It is made of clay and limes mixed in a six-to-four ratio to make a stiff mix, and kneaded for two days. Some amount of ash is combined with cattail (Typha) fibers, sometimes egg, and straw, and fixed, then beaten with a wooden stick for mixing. (<https://dbpedia.org/page/Sarooj>)

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